A

Synopsis of the proposed thesis entitled:

Accumulation of Trace Metals in the Water of Godavari River with Special Reference to Agricultural Runoff near Balegaon Dam, Nanded (MS)

To be submitted to

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Introduction

Water is very important for living beings on the earth. It is the most important prerequisite for the survival of life on planet Earth as they cannot survive without water. Water is the most fundamental natural resource essential for the well□being of biotic community and the planet earth. The Earth's surface consists 71% of water but only 0.7% are lentic and lotic fresh water inhabitants (Jain 2013). Many factors like economic growth, urbanization and environmental changes have put pressure on freshwater resources.

Water plays an important role in the world economy. Approximately 70% of the freshwater used by humans is required for agriculture. Fishing in Salt and fresh water bodies has been, and continues to be, a major source of food for many parts of the world, providing 6.5% of global protein.

The contamination of water bodies (ponds, lakes, rivers, streams, oceans, groundwater etc.) by physical, chemical or biological contaminants is termed as water pollution. The presence of dissolved organic, inorganic and other substances can adversely affect organisms and make the water unfit for desired uses (Bhosle and Rao, 2001, Mahajan, 2000). These contaminants get dissolved in water, remain suspended or get deposited inside the water bodies and degrade the water quality.

Human disturbances are continuously harming the environment through many ways. Anthropogenic activities are widely responsible to increase the toxic metals, especially in aquatic ecosystem and it is becoming an important worldwide problem. Nowadays, the pollution of water is at worst level. Most of our water resources are gradually becoming contaminated due to the addition of foreign materials from the surroundings (Lokeshwari, H., and Chandrappa, G.T., 2006). These materials include organic matter, agricultural wastes and runoff, industrial, sewage effluents and solid waste. It is also influenced by increased urbanization and industrialization without proper environmental planning and management.

The problem of water pollution due to toxic metals has begun to cause concern now in urban and rural areas of the world. The toxic heavy metals entering the ecosystem may lead to geo-accumulation, bioaccumulation and biomagnifications etc. Heavy metals like Fe, Cu, Zn, Ni and other trace elements are important for proper functioning of biological systems

and their deficiency or excess could lead to a number of disorders. As heavy metals cannot be degraded, they are deposited, assimilated or incorporated in water, and aquatic animals (Linnik and Zubenko, 2000) and act in food chain. Bioaccumulation results from a dynamic equilibrium between exposure from the outside environment and uptake, storage, excretion, and degradation within an organism.

The extent of bioaccumulation depends on the concentration of chemicals in the environment. The nature of the chemical itself, such as its solubility in water and fat, affects its uptake and storage. Equally important is the ability of the organism to degrade and excrete a particular chemical. One of the problems with many of the toxic substances is that they build up in the bodies of aquatic organisms to levels which can harm humans that consume them.

Bioaccumulation is a normal and essential process for the growth and nurturing of organisms. All animals, including humans, daily bio-accumulate many vital nutrients, such as vitamins A, D, K, trace minerals, essential fats and amino acids. What concerns toxicologists is the bioaccumulation of substances to levels in the body that can cause harm.

FACTORS AFFECTING BIOACCUMULATION:

Bioaccumulation varies between individual organisms as well as between species. Large, fat, long-lived individuals or species with low rates of metabolism or excretion of chemicals will bioaccumulate more than small, thin, short-lived organisms. The time between uptake and eventual elimination of a chemical directly affects bioaccumulation. Chemicals that are immediately eliminated for example do not bioaccumulate. Similarly, the duration of exposure in an organism is also a factor of bioaccumulation. Most exposures to chemicals in the environment vary continually in concentration and duration, sometimes including periods of no exposure. In these cases, equilibrium is never achieved and the accumulation is less than expected.

Bioaccumulation can result in injury to an organism only when the equilibrium between exposure and bioaccumulation is overwhelmed, relative to the harmfulness of the chemical. Self-poisoning with agricultural pesticides represents a major hidden public health problem.

Study Area

The area is covered from the Distance of twenty kilometer before Balegaon Dam. It is situated 45 km away from district headquarter Nanded. It has a gram panchayat. The total geographical area of village is 540.97 hectares. It has a total population of 1,555 peoples, out of which male population is 800 while female population is 755. Literacy rate of Balegaon village is 61.16% out of which 70.38% males and 51.39% females are literate. There are about 400 houses in this village surrounded by water canal and nearby villages such as Balegaon dam, Izatgaon, Izatgaon (bk), Manur, Chilpimpri, Bhayegaon, Izatgaon, Barbada, Rahati (bk), Rahati (kh) etc.

Sample Location (Village)	**Spatial Coordinate** Latitude	**Spatial Coordinate** Longitude
Balegaon Dam	18º58’14.53 N	77º35’23.71 E
Izatgaon	18’58’.33.76 N	77’35,914E
Izatgaon (bk)	18º59’22 N	77º34’21.09
Manur	18º59’52" N	77º33’19.00E
Manur Tarf Ba.	18.99567829 N	77.55159239” E
Chilpimpri	18°59'32.41"N	77°32'28.93"E
antargaon	18°59'35.94"N	77°31'44.60"E
Bhayegaon	18°59'49.08"N	77°31'47.15"E
Mahati (A)	19° 0'46.80"N	77°31'2.61"E
Ijjegaon P G (B)	19° 0'53.52"N	77°30'27.49"E
Barbada	19° 0'38.11"N	77°30'41.17"E
Rahati (bk)	18º5948.08”N	77º31’2.29”E
Rahati (Kh)	18º59’51.75”N	77º32’54.53"E

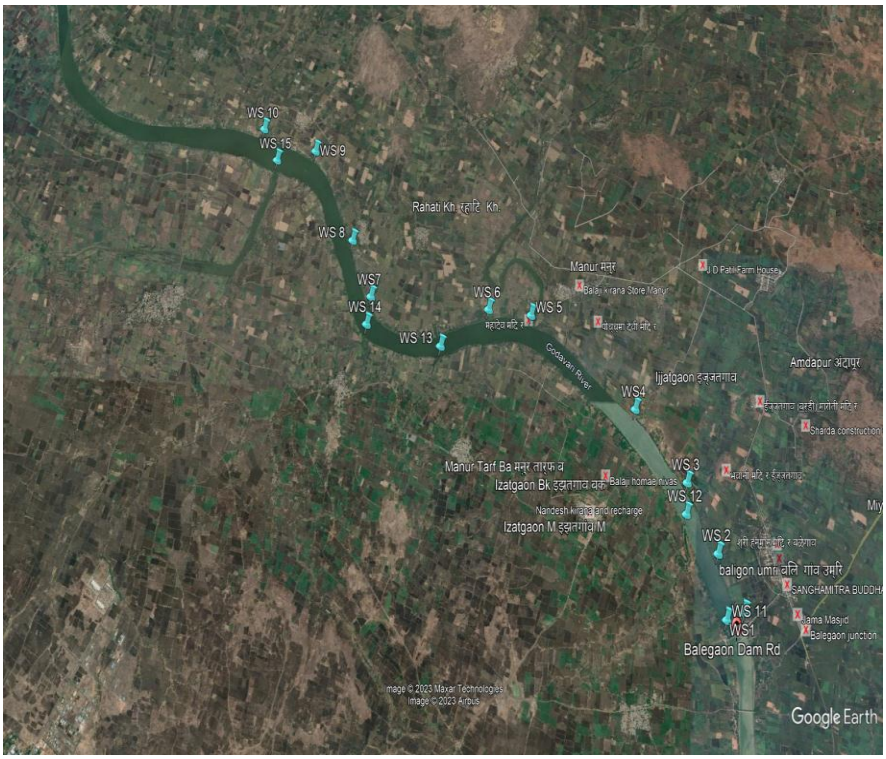

Image Showing selected Sampling Locations near Balegaon Dam on google Map

A scene of Gates and Water at Balegaon Dam

Review of Literature:

Some heavy metals are useful to plants and animals as micronutrients, but they can be exceptionally toxic if consumed in higher amounts. Because of their persistent nature, they get accumulate in food chains and develop increasing effect in humans (Bhosle et. al., 2001).

Heavy metals like Fe, Cu, Ni, and other trace elements are important for proper function of biological System and their deficiency or excess could lead to a number of disorders (Singh et. al., 2012).

Trace elements but the biologic special effects of numerous of them are of enormous worry found that some weighty metal have bioimportance as in human biochemistry (Durbi et. al., 2007).

Jain et. al., (2005) worked on Hindon river, Uttar Pradesh and investigated the metal pollution at 13 locations in river water. During 1997 to 1999, they observed that maximum metal concentration was observed in summer month and it decreases in the monsoon season because of dilution effect.

Osa-Iguehide (2016) in august 2013 analysed water from Ikpoba river, in Benin city, Nigeria to determine the pollution status. The heavy metal found in order of Pb > Cu > Zn > Cd for water. Most of the sample concentrations were below permissible limits by WHO and FEPA.

Some heavy metals are useful to plants and animals as micronutrients, but they can be exceptionally toxic if consumed in higher amounts. Because of their persistent nature, they get accumulate in food chains and develop increasing effect in humans (Bhosle et.al., 2001).

Nabil et. al., (2006) monitored the copper, lead, zinc, iron and cadmium levels in water from aquatic ecosystem of river Nile during April 2004 to March 2005. The lowest levels were recorded in summer and spring season and highest in winter and autumn season. They concluded that the industrial effluent directly discharged into the river accumulates the heavy metals in aquatic ecosystem.

Kumar et. al., (2017) assessed the impact of treatment plant effluent on surface water of river Ganga, Kanpur. Modulatory Effect of Tannery Effluents on Physico chemical quality of Ganga River water and its seasonal variation.

Wu et. al., (2014) studied the concentration of mercury, cadmium, lead, chromium, copper and arsenic from water of Hongfeng and Baihua freshwater reservoirs, in Southwest China. They used statistical and spatial analyses to detect the pollution sources. They conclude that industrial activities, lithogenic sources, air and traffic pollution were the vital contaminating sources.

Avila-Perez et. al., (1999) measured the concentration of zinc, iron, chromium, nickel, copper, and lead in water of Mexican reservoir to identify spatio-temporal division. The results showed that lead, chromium, mercury, zinc, copper, nickel and iron were dominant contaminants in studied reservoirs as they exceed Mexican standards.

Singh et. al., (2012) measured Cu, Cd, Cr, Ni and Zn metals to assess the status of water collected from selected sites of river Ganga during January 2007 –December 2008. Three sites were identified for assessment of heavy metals using AAS.

The problem of water pollution due to toxic metals has begun to cause concerns now in urban and rural areas of the world toxic heavy metals entering the ecosystem may lead to geo accumulation, bioaccumulation and biomagnification etc. (Prabhu, 2013).

Water quality standards are legal foundations for controlling water pollution from various industrial, agricultural, domestic and other sources (Saini, 2006).

According to Bhosle and Rao (2001), the contaminants get dissolved in water, remain suspended or get deposited inside the water bodies and degrade the water quality.

Water quality standards are legal foundations for controlling water pollution from various industrial, agricultural, domestic and other sources. It forms a basis for accepting or rejecting water proposed for human utilization, by providing minimum acceptable standards for human health safe guarding (Saini, 2006).

Objectives

The overall purpose of the present investigation is to understand the trace metal level in Balegaon water reservoir. The surrounding area is largely dependent upon Agriculture and its runoff is contributing many pollutants in the water system. A small increase or decrease

of these pollutants in food chain and in the human metabolism can have severe health impacts and hence it proves the importance of selecting this topic for the details study.

The Iron, Chromium, Manganese, Selenium, Zinc and Copper are selected to analyze from water with few other physico chemical parameters like pH, Temperature, EC, TDS, alkalinity and nutrients (N, P, K, Ca, Mg etc.)

AIMS AND OBJECTIVES:

1. To Observe the Concentration of Selected Physico chemical parameters (pH, Temperature, EC, TDS, alkalinity) in Dam water.
2. To Observe the Concentration of Selected Trace Metals (Iron, Chromium, Manganese, Selenium, Zinc and Copper) in Dam water.
3. To Observe the Concentration of Selected nutrients (N, P, K, Ca, Mg) in Dam water.
4. To Identify and Comment on natural and anthropogenic Metal Pollution sources.
5. To make awareness about probable health impacts from the research if any.
6. To give recommendation to the farmers and surrounding population based on the observations.

METHODOLOGY AND PROPOSED OUTCOMES:

Water samples will be collected along the dam for the selected analysis. The standard and widely used methods will be applied for the analysis. Water samples will be collected in polyethylene plastic bottles with caps. The water sample will be brought in the laboratory for further systematic analysis. The water sample will be collected once in a month for about two years. Considering the huge water storage sample sites are selected on the basic of various villages surrounding the dam area.

The physico chemical parameters like pH, Temperature, EC, TDS, alkalinity and nutrients (N, P, K, Ca, and Mg will be measured using standard methods. The investigations of selected trace metals in water will be carried out using following methods,

Table: Proposed methodology for the Analysis of Selected parameters

Parameters	Method and Instrument
pH	Electronic pH meter
Temperature	Standard centigrade thermometer in ºC
EC	Electric Conductivity meter
TDS	TDS meter
Alkalinity	Titrate method
Nitrate	Spectrophotometer
Phosphate	Spectrophotometer method
Potassium	Flame photometer
Calcium	Titrate method
Magnesium	Titrate method
Heavy Metals: Chromium, Iron Manganese Selenium Zinc Copper	ICP-OES

1. CHROMIUM (Cr):

It is the first element in Group VI with atomic Number 24. It is a steely-gray, lustrous, hard metal and has a high melting point. It is odorless, tasteless, and malleable. Chromium was regarded with great interest because of its high corrosion resistance property. Trivalent chromium (Cr^{+3}) is required in trace amounts for sugar and lipid metabolism. In larger amounts and different forms chromium can be toxic and carcinogenic. The most prominent example of toxic chromium is hexavalent chromium (Cr^{+6}).

It is estimated by the Diphenyl carbazide method using UV double beam spectrophotometer at wavelength of 540 nm and the result will be expressed in mg/L or mg/kg. The normal level of chromium in drinking water is 30-400 mg/lit, permissible level is 500 mg/lit. It is an essential metal, possibly carcinogenic. It is essential nutrient for plant and animal metabolism. However, when accumulated in high amount, it can generate trouble

and diseases like nausea, lung cancer and as the concentration reaches 100mg/lit, it can be lethal.

2. IRON (Fe):

It is a metal in the first transition series, most common element in the whole planet Earth, forming much of Earth's outer and inner core. Iron is a Chemical Element with the Symbol Fe. It is a Metal that belongs to the and group 8 of Periodic tables.

It is metal in first transition Series, Most Common element in Whole Planet Earth, forming much of earth out and inner core. iron plays an important role in biology, forming complexes with molecular oxygen in hemoglobin and myoglobin. Chemically, the most common oxidation states of iron are iron (II) and iron III. iron shares many properties of other transition metals, including the other group 8 elements, ruthenium and osmium. Iron forms compounds in a wide range of Oxidation States. −4 to +7. Iron also forms many coordination compounds. some of them, such as ferrocene, ferrioxalate, and Prussian blue have substantial industrial, medical, or research applications. Iron plays an important role in biology, forming complexes with molecular oxygen in hemoglobin and myoglobin; these two compounds are common oxygen transport proteins in vertebrates. Iron is also the metal used at the active site of many important redox enzymes dealing with cellular respiration and oxidation, reduction in plants and animals.

It is estimated by thiocyanate procedure using UV double beam spectrophotometer at wavelength of 510 nm and the result will be expressed in mg/L or mg/kg. Iron is most transition metal in the human body, 4.2 to 6.1 gm in an average man. It is a trace element, required by both plants and animals, also for microbial systems.

3. MANGANESE (Mn):

It found as a free element in nature and has many important industrial applications. It is estimated by using Persulphate procedure using UV double beam spectrophotometer at wavelength of 545 nm and the result will be expressed in mg/L or mg/kg. Manganese is a grayish white metal similar in appearance of cast iron. It occurs in cells of all living organisms. It is considered as twelfth most abundant element and the fifth most abundant metal. It is also used in photosynthetic oxygen evolution.

Manganese is an essential element in nature and commonly present in all rocks of earth's crust. The highest concentrations (up to several thousand mg/kg) are found in basic igneous rocks such as basalt and gabbro's, however, in metamorphic ary rocks its contents vary widely from 200 to 1000 mg/kg. This element is the eleventh most abundant element by mass in the human body

It also plays an important role in several metabolic processes such as bone growth, glucose tolerance, reproduction and development of inner ear. It is found in variety of enzymes like Pyruvate, Carboxylase and oxaloacetate decarboxylase where it functions primarily as Levis acid.

4. SELENIUM (Se):

It is estimated by diaminobenzidine method using UV double beam spectrophotometer at wavelength of 420 nm and the result will be expressed in mg/L or mg/kg. It is an essential nutrient for humans and animals that to promote a healthy immune system. The FDA recommends a dietary allowance of 55 µg a day, which can be obtained through grains, cereals, sea food and animal organs. It is comparable to arsenic in toxicity towards man and animal. it is passively carcinogenic in nature. Its permissible limit is 100 mg/lit. It is essential at low levels but toxic at high levels.

Selenium is also by-product of copper refining, which can release the mineral into the air and water. As plants and animals consume selenium containing water, concentration accumulates, leading to potentially harmful effects. Livestock develop "blind staggers," a disease characterized by impaired vision, aimless wandering, reduced food and water consumption and paralysis.

In humans, high amounts of ingested selenium can cause hair loss, deformed nails, tooth decay, fatigue, liver and spleen damage, and loss of feeling and control in extremities. Other selenium compounds have been found to cause nausea, headaches, dizziness, rashes, respiratory problems and even cancer. So, while it is a necessary nutrient, bioaccumulation can create elevated levels of selenium that are toxic to animals and humans.

5. ZINC (Zn):

Zinc is a chemical element with the symbol (Zn) and atomic number (30). Zinc is a slightly brittle metal at room temperature and has a shiny-greyish appearance when oxidation is removed. It is the first element in group 12 (IIB) of the periodic table. Zinc is an essential trace element for humans, animals, plants and for microorganisms and is necessary for prenatal and postnatal development. It is the second most abundant trace metal in humans after iron and it is the only metal which appears in all enzyme classes. Zinc is also an essential nutrient element for coral growth as it is an important cofactor for many enzymes. Zinc deficiency affects about two billion people in the developing world and is associated with many diseases. In children, deficiency causes growth retardation, delayed sexual maturation, infection susceptibility, and diarrhea. Enzymes with a zinc atom in the reactive center are widespread in biochemistry, such as alcohol dehydrogenase in humans. Consumption of excess zinc may cause ataxia, lethargy, and copper deficiency.

6. COPPER(Cu):

Copper is a chemical element with atomic number 29. It is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. A freshly exposed surface of pure copper has a pinkish-orange color. Copper is used as a conductor of heat and electricity, as a building material, and as a constituent of various metal alloys, such as sterling silver used in jewelry, cupronickel used to make marine hardware and coins, and constantan used in strain gauges and thermocouples for temperature measurement.

Copper is essential to all living organisms as a trace dietary mineral because it is a key constituent of the respiratory enzyme complex cytochrome c oxidase. In molluscs and crustaceans, copper is a constituent of the blood pigment hemocyanin, replaced by the iron-complexed hemoglobin in fish and other vertebrates.

Significance of Present Work:

Metals have worldwide importance in running out all the biological systems including terrestrial and aquatic ecosystems. Fresh water resources like fishes, prawns, shells and many other aquatic organisms have huge consumption percentage in daily diet of the society, as well as many of them are medicinally important. It enhances the importance of such studies as metals are having direct impacts on consumers including humans. Because of this, we have selected to study the metal behavior in aquatic ecosystem. Overall considering the scope and importance of the study after completing the above mention objectives, all the metal analysis results will be compared with standard water permissible levels of world known authorities.

Metals are transported from nearby silts, rocks and domestic and agricultural runoff etc. these metals play an important role in supplying micro-metals for human consumption. It is required to investigate few metals which are essential for our life.

Metals are transported from nearby Silts, rock and Domestic and Agriculture runoff etc. These Metals Play an important role in Supplying micro metals for human consumption. it is required to investigate few metals which are Essential for our Life. Hence Following metals are Selected for the Proposed Study. Sample Will be analyzed in Laboratory.

The present work will be instrumental identifying the level of pollution especially heavy metal Status Sources in Water of Balegaon water Reservoir and surrounding areas mainly from the agricultural runoff.

1. It is useful for the agriculture Purpose.
2. This Work is useful for the fisherman for fish production
3. This work is giving economic support to the farmers and fisherman
4. It will provide information about nutrients in water and pollution status in the surrounding aquatic ecosystem.

National and International Status:

Water pollution caused 1.8 million deaths in 2015, according to a study published in The Lancet. Contaminated water can also make you ill. Every year, unsafe water sickens about 1 billion people internationally.

According to the 2021 World Water Development Report released by UNESCO, the global use of freshwater has increased six-fold in the past 100 years and has been growing by about 1% per year since the 1980s. With the increase of water consumption, water quality is facing severe challenges. Industrialization, agricultural production, and urban life have resulted in the degradation and pollution of the environment, adversely affecting the water bodies (rivers and oceans) necessary for life, ultimately affecting human health and sustainable social development (Xu et al., 2022). Globally, an estimated 80% of industrial and municipal wastewater is discharged into the environment without any prior treatment, with adverse effects on human health and ecosystems. This proportion is higher in the least developed countries, where sanitation and wastewater treatment facilities are severely lacking.

This study is useful for the agriculture purpose also in the irrigation purpose. It also identifies trace metals in the dam water and when this trace metal reduces. It is also useful for drinking purpose and daily routing. It is useful for production of fishing purpose. The nature and extent of change depends largely on the concentration of heavy metal species in the water. The first category emphasizes that conditions in receiving waters may lead to a change in the speciation and toxicity of metals.

Proposed Work Plan:

Time (month)	Work
0-10	Review of literature, Pre-sampling and laboratory preparation
10-34	Sampling, analysis, data collection and interpretation of data, publication of result
35 -36	Thesis Writing and Submission

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Sign of Research Student

Sign of Research Guide

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